A New Frog of the Genus *Rana* from Western Mexico with a Key to the Mexican Species of the Genus

By Richard G. Zweifel

During the summer of 1953, Mr. William J. Riemer and the author spent several weeks in western Mexico collecting animals for the Museum of Vertebrate Zoology. At two places along the Durango—Mazatlán highway on the western slope of the Sierra Madre Occidental in Sinaloa, individuals of what appeared to be an undescribed species of *Rana* were captured. Subsequent comparison with specimens of all other similar species of *Rana* known from Mexico confirmed the distinctness of the new form. It is proposed that the species be named

Rana sinaloae sp. nov.

Holotype.—Adult female, Number 58962, Museum of Vertebrate Zoology, taken by R. G. Zweifel 14 miles by road southwest of El Batel, Sinaloa, Mexico, at an elevation of 4200 feet on July 12, 1953. El Batel is about 33 miles air line distance east and 15 miles north of Mazatlán.

Paratypes.—Seven paratypes are available, numbers 58959-

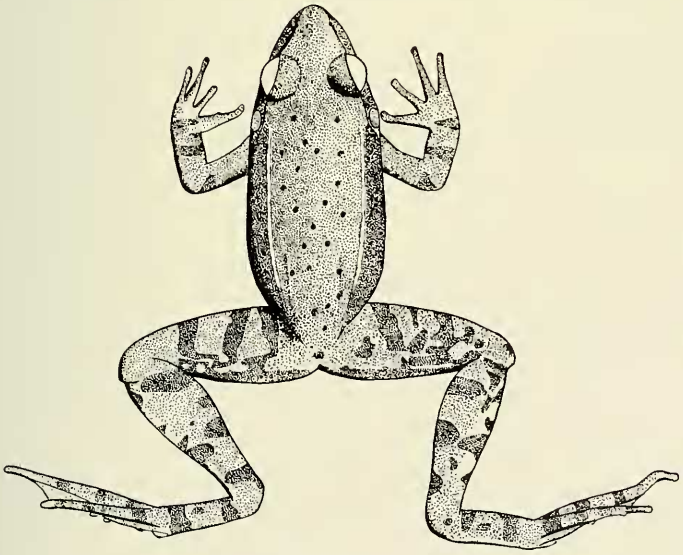

PLATE 37

Type specimen of *Rana sinaloae* in dorsal aspect.

58961 and 58963-58965, all juveniles collected by William Riemer and Richard Zweifel at the same time and place as the type specimen, and number 58966, an adult, found 10 miles by road northeast of El Batel, 6400 feet elevation, on the same day.

Description.—The following account holds true for both juveniles and adults, except where otherwise noted: Head as long as wide, snout relatively narrow. Eyes large, interorbital distance about width of upper eyelid. Tympanum distinct, about one-half the length of the eye, or a little more. A distinct fold of skin from the posterior corner of the eye over and behind the tympanum, terminating behind the angle of the mouth above the insertion of the fore-limb; this fold is indistinct in the smallest specimens. A distinct though narrow dorsolateral glandular fold runs from above the tympanum and terminates short of the groin. This fold is indistinct in the juvenile specimens. The dorsal body surface is minutely pustulose. The first finger is longer than the second, and all have large sub-articular tubercles. The hind feet have extensive webbing, expanded toe tips and large, elongate sub-articular tubercles. A single elongate metatarsal tubercle, twice as long as wide, is present.

The following measurements are given in millimeters. The first measurement of each pair represents the type specimen, number 58962, the second specimen number 58966: Snout-vent, 65.2, 58.1; head width (at angle of mouth) 24.2, 20.8; head length (tip of snout to angle of mouth) 24.0, 20.4; tibia length 32.8, 32.3; length of tympanum 4.8, 3.9.

In life the dorsal coloration is brown. The dorsolateral folds are white, the side of the head and lateral surface of the body below the folds very dark brown, almost black. The dark lateral coloration terminates rather abruptly on a line connecting the lower edge of the eardrum and the middle of the upper surface of the femoral insertion. The light area below this line is separated from the white venter by a series of dark markings or an ill-defined dark band beginning at the axilla and passing posteriorly almost to the femoral insertion. There is a distinct light line beginning on the snout and passing along the upper lip, beneath the eardrum and over the foreleg and meeting the light lateral area described above. Numerous small and diffuse dark spots are present on the back.

Diagnosis.—The relationships of this new species seem to lie with *Rana palmipes*, *R. sierramadrensis* and *R. macroglossa*.

Rana sinaloae may be most easily distinguished from *R. palmipes* by the relative size of the tympanum, which is much larger in *palmipes*. The eardrum is about one-half the length of the eye in *sinaloae* and two-thirds to three-quarters the eye

length in *palmipes*. The prominent supra-and post-tympanic fold of *sinaloae* is lacking in *palmipes*. Leg length is similar in the two species, but *palmipes* has relatively smaller expansion of the toe tips. Some of the proportional characters discussed here and in subsequent paragraphs are presented in ratio form in Table I.

Rana sierramadrensis has longer hind legs than *sinaloae* (Table I), and resembles *palmipes* in lacking a well developed tympanic fold. With respect to size of tympanum and toe pads, *sinaloae* and *sierramadrensis* are similar. The white color of the dorsolateral folds of *sinaloae* is not seen in *sierramadrensis*, and no mention of it is made in Taylor's original description (1939: 399). In *sierramadrensis* the dorsolateral folds are continuous past the groin, while in the two adult specimens of *sinaloae*, they become indistinct before reaching the groin.

TABLE I

Species	N	Tibia length / Snout-vent length	Tympanum length / Head width
sinaloae	2	.518–.555	.18–.19
sierramadrensis	6	.610±.008 (.575–.630)	.160±.004 (.15–.18)
macroglossa	4	.600 (.563–.646)	.187 (.18–.20)
palmipes	15	.523±.005 (.479–.544)	.247±.004 (.22–.27)

Some proportional characteristics of *Rana sinaloae* and related species. Juvenile specimens have been omitted from these calculations. In *sierramadrensis* and *palmipes* the figures given are the mean, standard error of the mean, and range. Only Mexican specimens of *palmipes* are included here.

Rana macroglossa (sensu Schmidt and Stuart, 1941: 239-241) must also be considered as a relative of *R. sinaloae*. At present, *macroglossa* is known from Guatemala, El Salvador and extreme western Honduras. The Museum of Vertebrate Zoology has specimens from several localities in El Salvador. To judge from the four largest specimens in the MVZ collection, the hind limb of *macroglossa* is as long as that of *sierramadrensis* and thus differs from that of *sinaloae*. In tympanum size, these three species are similar and differ from *palmipes*. The toe tips of *macroglossa* are somewhat less expanded than those of *sinaloae* and *sierramadrensis*, and the webbing of the hind feet is less extensive. According to descriptions given by both Mertens (1952:32) and by Schmidt and Stuart (*op. cit.*, 240), *R. macroglossa* possesses considerable green coloration in life, resembling *palmipes* and differing from both *sinaloae* and *sierramadrensis* which in life are various shades of brown.

THE PALMIPES SPECIES GROUP

Within any genus so large as *Rana*, it is generally possible to recognize groups of similar and apparently closely related species. When dealing with frogs, however, there arises some difficulty in finding objective characters to reenforce general impressions of similarity.

The forms *palmipes, sierramadrensis, macroglossa* and *sinaloae* seem to constitute a species group. Stuart (1948:41) has stressed the closeness of *macroglossa* and *palmipes* while Taylor (1938:398) considers *palmipes* and *sierramadrensis* to belong to the same group. The similarity of *Rana sinaloae* to these species has been brought out in the foregoing account. All these species agree in the possession of dorsolateral glandular folds, some expansion of the toe tips, extensive webbing of the hind feet, and all have similar head shape, the head relatively narrow and about as broad as long. Varying degrees of development of a black face mask bordered below by a light line along the upper lip is present in these forms, and lends a similarity to the woodfrog, *Rana sylvatica,* and its American and Eurasian relatives.

The use of larval characters as an aid in defining species groups deserves and should receive more attention as larvae become better known (Orton, 1952: 389-390). Unfortunately, the larvae of *sierramadrensis* and *sinaloae* are as yet unknown.

When sufficient skeletal material becomes available, similarities and differences in skeletal structure may be expected to further clarify species group relationships. A skeleton of *Rana sinaloae* has been available, but the specimen was unfortunately immature and the skull not well ossified. Characteristics of the frontoparietal region of the skull, particularly the configuration of the dorsal surfaces of the frontoparietal bones, will possibly be usable in the definition of species groups. It should be emphasized that skeletal structures, just as most other structures used in classification, are individually variable; a large series of specimens is usually needed here just as in a study of external morphology.

As it is considered here, the *palmipes* species group consists of the forms *Rana palmipes, R. sinaloae, R. sierramadrensis* and *R. macroglossa,* and possibly other Central American forms which I have not investigated. *Rana palmipes* is a species which occurs mainly at relatively low elevations from central Veracruz and the Tehuantepec region of Oaxaca in Mexico south into northern South America, being the only *Rana* known from that continent. A record for *palmipes* from Cuernevaca, Morelos (Kellogg, 1930: 202) will require further substantiation. Some of the records for the Pacific slopes of Oaxaca and Chiapas as indicated on the

range map (Plate 39) represent literature records for which I have seen no specimens. Some of these may represent species other than *palmipes*. However, I have examined a *palmipes* (EHT-HMS 3155) from Asuncion, Chiapas, a locality on the Pacific slope.

PLATE 38

Type specimen of *Rana sinaloae*, lateral aspect. From a kodachrome by William J. Riemer.

The other three species of the group seem to be montane or at least foothill forms. *Rana sinaloae* is known at present only from two nearby localities on the western slope of the Sierra Madre Occidental in Sinaloa. A specimen, No. 34404 in the collection of the United States National Museum, possibly represents this species. It bears the data Mazatlán, Mexico, November 1921, J. M. Gallegos and has been catalogued in the Museum as *Rana pustulosa*. The specimen is in poor condition, having been considerably broken up by shot and preserved in a somewhat contorted position. These features, combined with fading of important characters of color and pattern, make it inadvisable to give a specific identification to the specimen. In any event, it is not

Rana pipiens, the only *Rana* known from the coastal region of Sinaloa (presuming that the Mazatlán referred to is the one in Sinaloa). The town of Mazatlán itself would seem an unlikely place for either *sinaloae* or *pustulosa*, unless washed down from the mountains by flood waters.

PLATE 39

Distribution of the members of the *palmipes* group in Mexico and northern Central America.

Rana sierramadrensis has been previously recorded only from the Sierra Madre del Sur of Guerrero, at and near the type locality of Agua del Obispo. It is now possible to report a new locality for this species, based on a specimen in the American Museum of Natural History, No. 52624. This individual was taken by T. C. MacDougall at Santa Lucia, Oaxaca, and constitutes an extension of range of some 280 miles to the east-southeast of the type locality.

Rana macroglossa is known to occur in the mountains of Guatemala, El Salvador and extreme western Honduras.

The probability of occurrence of members of this species group in the mountains of Chiapas and in montane regions between Sinaloa and Guerrero is high. In this regard, the following quote from Günther (1885-1902: 202) is of interest: "Some small frogs collected by Dr. A. C. Buller at the Hacienda Santa Gertrudis, Jalisco, may possibly be the young of this species *[pustulosa];* their snout is, however, more pointed; . . . A whitish line runs along the glandular fold, and another, broader and more distinct, along the upper lip and side of the abdomen." These may well be the young of *Rana sinaloae.*

It is entirely possible that intermediates between *R. sinaloae* and *R. sierramadrensis* may be found in the intervening 400 miles between the known localities for the two forms. However, I feel that it would be presuming too much to refer them to a single species at our present state of knowledge.

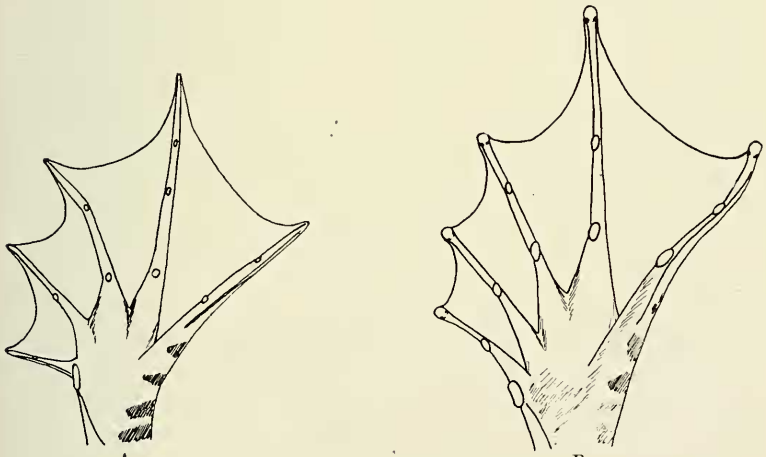

PLATE 40

Fig. A. Left hind foot of *Rana montezumae* to show small, rounded subarticular tubercles and pointed toe tips.

Fig. B. Left hind foot of *Rana pustulosa* to show large, elongate subarticular tubercles and expanded toe tips.

Habitat of *Rana sinaloae*

The type locality lies at an elevation of about 4200 feet at the upper margin of the Tropical Deciduous Forest. Pines are present on slopes above the stream. The stream from which the type specimen and several juveniles were taken is narrow, seldom more than four feet wide, and runs a relatively steep course with numerous small waterfalls and pools up to three feet deep and ten feet in diameter. The stream is on bedrock much of the way. The water temperature of the pool from which the type specimen was taken was 23.5°C. in the mid-afternoon. Some frogs were in the water when first seen, but others were perched as far as eight feet above the water on boulders.

Where several frogs were seen and one captured ten miles northeast of El Batel, 6400 feet, the stream was essentially identical in character to that at the type locality. This second locality was in the pine-oak zone, well above the Tropical Deciduous Forest.

KEY TO THE *RANA* OF MEXICO

With the description of *Rana moorei* Blair, 1947, and *Rana sinaloae* in the present paper, the number of species of *Rana* known from Mexico (excluding Baja California) is increased from the eight known at the time of publication of the most recent key (Smith and Taylor, 1948) to ten. Rather than attempt to fit these species into the Smith and Taylor key, I have attempted to devise a new key which will suitably identify the Mexican *Rana* as they are presently known. I have confined this key to the forms occurring in mainland Mexico, omitting *Rana aurora draytoni* of northwestern Baja California.

In constructing the present key, I have avoided the use of proportional characters of leg length which require a considerable degree of bending of the legs with inevitable damage to all but the most pliable specimens. Specimens of all currently recognized Mexican species of *Rana* except *R. megapoda* have been examined and directly compared in the course of this study. The general statements of range given in the key are taken from Smith and Taylor (1948) except where otherwise noted, and refer to the distribution in Mexico only. The key has been constructed so that species presumably closely related will key out in the same part of the key.

The first alternative involving the size and shape of the subarticular tubercles will offer some difficulty if the user of the key is not familiar with the variations to be expected in the several

species. Also juveniles will prove somewhat more difficult to evaluate than adults. Drawings of typical examples of the classes of subarticular tubercles and toe tips have been included to facilitate keying. In addition to the key characters, some further identifying characters have been added in parentheses to the final dichotomy in the case of some of the species. These characters will not necessarily separate the species from those nearby in the key, but should aid users of the key to realize when a species actually somewhat far removed in the key has been misidentified. In the absence of specimens of *Rana megapoda*, the key characters for that species have been taken from the checklist of Smith and Taylor (1948).

KEY TO THE *RANA* OF MEXICO

1A Subarticular tubercles of hind feet large, elongate; toe tips more or less expanded (Plate 40, fig. B)..... 5

1B Subarticular tubercles of hind feet small, rounded; toe tips usually pointed (Plate 40, fig. A)..... 2

2A Dorsolateral folds present; male with external vocal sacs which protrude behind angle of mouth; back with or without elongate pustules or folds between dorsolateral folds. *Pipiens* group..... 3

2B No dorsolateral folds; male without integument modified as external vocal sac; back without elongate pustules or folds; (tympanum distinct, slight-larger than to much larger than eye). *Rana catesbeiana.* Northeastern Mexico; Nuevo Leon, Tamaulipas, San Luis Potosi, Puebla, Veracruz. Introduced elsewhere, as Parral, Chihuahua.

3A Dorsolateral fold well-defined, continuous nearly to groin and with discontinuous sections to above femur; a light stripe frequently present from beneath eye to beneath lower edge of tympanum; (back usually with elongate pustules between dorsolateral folds.) *Rana pipiens.* All of Mexico except possibly the extreme northwestern desert region of Sonora.

3B Dorsolateral fold usually less distinct, usually terminating before groin and with no discontinuous section to above femur; none or a very indistinct white stripe from beneath eye to beneath lower edge of tympanum..... 4

4A Belly usually unicolor; first finger longer than second; usually longitudinal ridges or pustules between dorsolateral folds. *Rana montezumae.* Southern tip of the central Mexican plateau.

4B Belly reticulated; first finger equal to or shorter than second; pustules or ridges between dorsolateral folds indistinct if present at all. *Rana megapoda.* Jalisco, around Lake Chapala.

5A Dorsolateral folds well developed, continuous past sacrum, or if indistinct posteriorly, ear ⅔ diameter of eye or larger; dark face mask and white line along upper lip frequently present. *Palmipes* group 6

5B Dorsolateral glandular folds absent or if present, usually poorly developed, becoming interrupted in region of sacrum; ear ⅔ diameter of eye or less; no dark face mask, white line on upper lip present or absent. *Boylei* group[1] 8

6A Ear large, ⅔ diameter of eye or more. *Rana palmipes.* See Plate 39 for range.

6B Ear smaller, less than ⅔ eye diameter 7

7A A distinct fold of skin above and behind the tympanum; dorsolateral fold not extending back of groin, white in life. *Rana sinaloae.* See Plate 39 for range.

7B No distinct fold of skin behind tympanum; dorsolateral fold extending back of groin, not white in life. *Rana sierramadrensis.* See Plate 39 for range.

8A A distinct white line running from beneath eye along upper lip to insertion of forelimb; head about as long as broad (at angle of mouth); no dorsolateral folds. *Rana moorei.* Known only from near Palictla, San Luis Potosí.

8B No such distinct white line on upper lip; head slightly broader than long; dorsolateral folds present or absent 9

9A Tympanum indistinct, frequently granular; no dorsolateral glandular folds. *Rana tarahumarae.* Western slopes of the Sierra Madre Occidental in Sonora and Chihuahua. (Records for Jalisco based on *R. pustulosa.*)

9B Tympanum distinct, smooth; dorsolateral folds usually present, but often weakly indicated. *Rana pustulosa.* Mountainous regions from west-central Durango south and west of the plateau to Oaxaca. (Record for Sonora based on *R. tarahumarae.*)

[1]The species for which the group is named, Rana boylei, is not found in Mexico.

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